UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Gravelly

Site ID: R042XB010NM

Major Land Resource Area: 042 - Southern Desertic Basins, Plains, and Mountains

Physiographic Features

This site usually occurs as a complex of soils, slope, direction of slope, and general topography along footslopes of desert mountains and the side slopes of arroyos and watercourses. the landscape is characterized by low hills and ridges, fans or foot slopes. Slopes average less than 5 percent but range as high as 30 percent. Aspect is variable. elevations range from 3,700 to 5,000 feet.

Land Form: (1) Mountain slope
(2) Mountainside

	Minimum	Maximum
Elevation (feet):	3700	5000
Slope (percent):	5	30
Water Table Depth (inches):	N/A	N/A
Flooding:		
Frequency:	Rare	Very rare
Duration:	Very brief	Extremely brief
Ponding:		
Depth (inches):	0	0
Frequency:	None	None
Duration:	None	None
Runoff Class:	N/A	N/A
Aspect:	North South West	

Climatic Features

Annual average precipitation ranges from 8 to 10.5 inches. Wide fluctuations from year to year are common, ranging from a low of about 2 inches to a high of over 20 inches. At least one-half of the annual precipitation comes in the form of rainfall during July, August, and September. Precipitation in the form of snow or sleet averages less than 4 inches. The average annual air temperature is about 61 degrees F. Summer maximums usually exceed 100 degrees F and winter minimums can go below zero. The frost-free season normally exceeds 200 days and extends from April 1 to November 1. Both the temperature regime and rainfall distribution favor warm-season perennial plants on this site. Spring moisture conditions are only occasionally adequate to cause significant growth during this period of the year. High winds from the west and the southwest are common from March to June, which further tends to create poor soil moisture conditions in the springtime.

	Minimum	Maximum
Frost-free period (days):	179	212
Freeze-free period (days):	200	233
Mean annual precipitation (inches):	9.39	10.5

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.37	0.36	0.23	0.18	0.29	0.57	1.42	1.92	1.53	1.01	0.48	0.57
Precip. Max.	0.54	0.39	0.27	0.36	0.45	0.64	1.9	2.2	1.66	1.07	0.58	0.78
Temp. Min.	20.8	25.5	31.2	38.0	46.4	54.3	61.1	59.1	51.5	39.8	28.8	22.3
Temp. Max.	58.1	63.8	71.0	79.3	87.4	96.4	95.5	92.7	87.5	78.7	67.2	58.5

Climate Stations:
(1) NM3855, Hatch. Period of record 1961 - 1990
(2) NM8387, Socorro. Period of record 1961 - 1990

Influencing Water Features

This site is not influenced by water from wetland or stream.

Wetland Description: (Cowardin System)	System	Subsystem	Class

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Representative Soil Features

Soils are shallow to deep. They formed in calcareous gravelly alluvium. The surface and underlying layers are calcareous gravelly or very gravelly loams and fine sandy loams to either an indurated caliche layer or zone hig in calcium carbonater within 20 inches. The soils are well drained and moderately permeable with low water-holding capacity. Slopes average less than 5 percent but range as high as 30 percent.

Predominant Parent Materials:
Kind: Alluvium
Origin: Mixed-calcareous

Surface Texture:	(1)	Gravelly Loam
	(2)	Very gravelly Fine sandy loam
Subsurface Texture Group:		Loamy
Surface Fragments <=3" (% Volume):		35
Surface Fragments > 3" (% Volume):		3
Subsurface Fragments <=3" (% Volume):		35
Subsurface Fragments > 3" (% Volume):		3
Drainage Class:		Well drained To Well drained
Permeability Class:		Moderate To Very slow

	Minimum	Maximum
Depth (inches):	10	60
Electrical Conductivity (mmhos/cm):	0	4
Sodium Absorption Ratio:	0	0
Calcium Carbonate Equivalent (percent):	0	0
Soil Reaction (1:1 Water):	7.4	8.4
Soil Reaction (0.01M CaCl2):	N/A	N/A
Available Water Capacity (inches):	1.0	5.0

Plant Communities

Ecological Dynamics of the Site

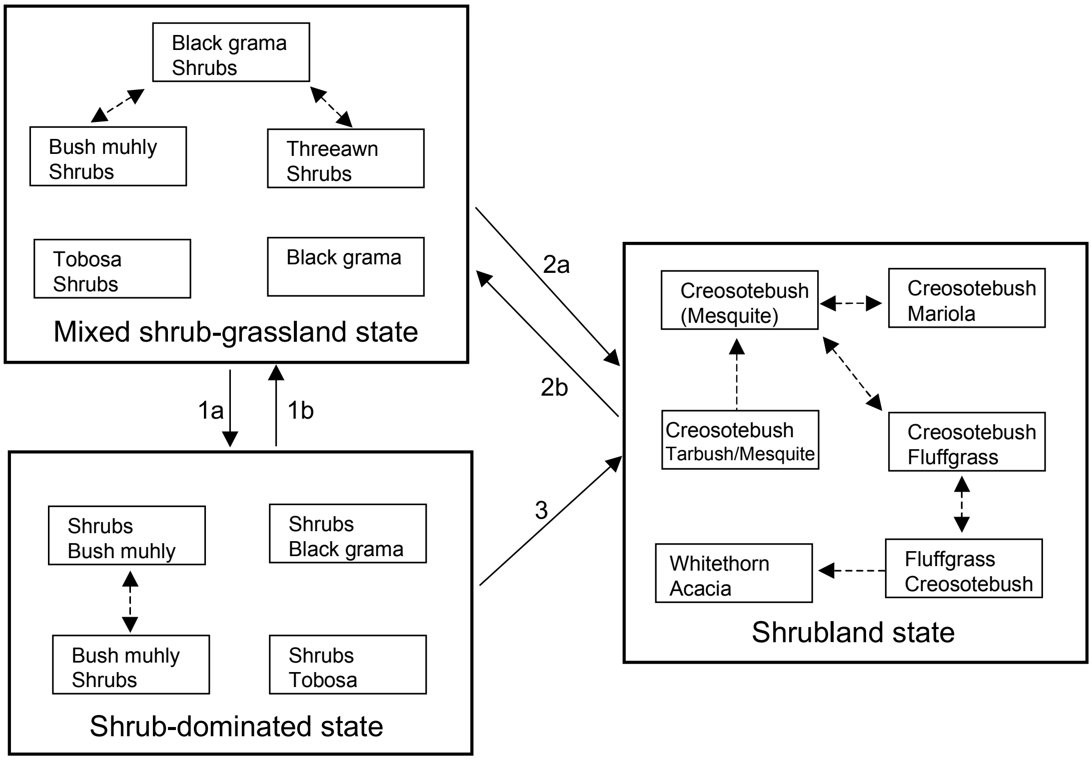
Overview

This ecological site may exist with inclusions of gravelly sand, gravelly loam, or sandy ecological sites. On bajadas, it often grades into gravelly loam and loamy ecological sites. The presence of a shallow petrocalcic layer in this site limits productivity and is an important aspect of its ecology. As currently defined, the gravelly site exhibits a high degree of topographic diversity. The historic plant community type is generally assumed to exhibit co-dominance between grasses, including black grama (*Bouteloua eriopoda*) and bush muhly (*Muhlenbergia porteri*), and shrubs and half-shrubs, chiefly creosotebush (*Larrea tridentata*) and mariola (*Parthenium incanum*). Due to variation in aspect, slope, landscape position, and subsurface soil properties, there is likely to have been considerable variation in historic plant communities within and among gravelly soil series. In cases where natural erosional slopes occur along bajadas (e.g. the erosional fan remnant of the fan piedmont landform; Wondzell et al. 1996), creosotebush may have dominated plant communities since pre-colonization times (Stein and Ludwig 1979). In the upper fan collar near the base of desert mountains, on the other hand, runon water to loamy-skeletal soils may currently support black-grama dominated communities with few shrubs.

Transitions from mixed shrub grasslands to a mixed shrub-dominated state may be catalyzed by overgrazing (Whitford et al. 2001) which reduces grass competition to shrubs. Drought and or fire suppression may also be important factors although this has not been demonstrated. In these cases, creosotebush and tarbush (*Flourensia cernua*) may be climax species that, without disturbance, come to dominate on certain soils (Muller 1940, McAuliffe 1994). Transitions to the shrubland state are associated with severe and persistent grass cover reduction, erosion, and soil truncation (Gile et al. 1998). Buffington and Herbel (1965) documented waves of invasion and replacement among tarbush, honey mesquite (*Prosopis glandulosa*), and creosotebush whose sequence differed on different gravelly soil series. Furthermore, there have been recent increases in whitethorn acacia (*Acacia constricta*) with declines in creosotebush on some gravelly soils (Bestelmeyer, in preparation). The causes of creosotebush encroachment throughout the southwest are potentially numerous. Together, the various studies of this shrub's biology highlight the complexities involved in modeling and managing grassland conversion.

Despite these studies, little quantitative information exists concerning the causes of transitions among states in SD-2. No systematic studies exist regarding the effects of range management on grassland-shrubland transitions in the gravelly ecological site group. McAuliffe's (1994) studies of creosotebush distribution in the Sonoran desert provide an interesting basis for comparative work in the Chihuahuan desert. Such broad-scale comparisons will provide important clues to the factors regulating creosotebush encroachment in SD-2.

State-Transition model: MLRA 42, SD-2, Gravelly subgroup: Gravelly



1a. Overgrazing, summer drought, or lack of fire; 1b. Shrub control
2a. Severe overgrazing, widespread grass mortality, with erosion and soil truncation
2b. Shrub control with soil addition or modification and stabilization
3. Persistent reduction in grasses, competition by shrubs, erosion and soil truncation

MLRA 42; SD-2; Gravelly

Mixed-shrub grassland state

•Left, black grama/ creosotebush community in breaks setting (Sierra Co., Nickel soils).
•Grass cover is high, little evidence of erosion.
• Right, bush muhly is the dominant grass, black grama is absent (Dona Ana Co., Terino sandy loam).
•Note larger bare patches but bush muhly occurs away from shrub canopy.

Shrub-dominated state--effects of slope and aspect

•Shrub-dominated state
•South-facing slope of a ridge in Socorro County, Nickel soils.
•Sparse black grama, bush muhly and fluffgrass cover. Lots of bare ground.

•Shrub-dominated state
•Top of the same ridge at left
•Higher cover of bush muhly, less black grama, purple prickly pear noticeably abundant. Less bare ground

•Mixed-shrub grassland state
•North-facing slope of ridge
•Very few creosotebush, dense cover of black grama. Small bare ground patches.
Note sole juniper.

Creosotebush state

•A virtual monoculture of dense creosotebush.
•No grass, note continuous layer of packed gravel at right.
•Terino sandy loam, Dona Ana Co.

State Containing Historic Climax Plant Community

Mixed-shrub grassland: The historic plant community is believed to have been dominated by grasses, especially bush muhly and black grama, and sometimes dropseeds (*Sporobolus* spp.). Shrubs, especially creosotebush, are co-dominants (black grama/shrubs community). Production is generally low (up to 450 lbs/acre) compared to other ecological sites. The biomass of bush muhly and black grama may be equal to that of creosotebush. Few such communities occur in gravelly ecological sites today. Grazing-induced retrogression from this community is characterized by a reduction in the cover of black grama, and may result in an increase in the proportional representation of bush muhly (bush muhly/shrub community). This is paralleled an increase in bare ground and the cover of fluffgrass (*Dasyochloa pulchella*). In other cases, bush muhly may either decline alongside black grama or have been a minor component, and threeawns (*Aristida* spp) may increase (threeawn/shrub community). It is possible that shifts in the dominance of black grama and bush muhly occur in response to climatic variation as well, but this is not known.

Additional communities may be observed that differ from the historic climax plant community described in the 1979 range site description due to landscape position or variations in soil texture. Where gravelly sites (as currently defined) occur in the upper portions of fan collars at the bases of desert mountains (i.e. Mt. Summerford, College Ranch, Doña Ana Co.; Wondzell et al. 1996), run-on water and low erosion rates appear to create conditions that are favorable to black grama grassland maintenance and few shrubs occur (black grama community). Further away from the mountain front on the lower fan collar, erosion is greater and the black grama/shrubs community is supported.

In areas of gravelly hills or "breaks" along the sides of the Rio Grande Valley, arroyos draining into the valley separate ridges of Gravelly soils (known as ballenas). Soil properties and vegetation vary with position across the ridge and with changing aspect. At one site in Sierra County (Gene Adkins NRCS, Brandon Bestelmeyer, USDA-ARS, and George Chavez, NRCS, personal observations), some ridge tops had less clay and more calcium carbonate than on side slopes. Ridge tops were dominated by creosotebush with a sparse cover of fluffgrass and no other grasses. North-facing slopes supported a mixture of black grama and sideoats grama (*Bouteloua curtipendula*) as dominants. South-facing slopes often supported large patches of tobosa (*Pleuraphis mutica*). At a similar site in Socorro County, soil properties did not vary with aspect but vegetation did (see photos). Ridge tops were dominated by creosotebush whereas north-facing slopes were dominated by black grama; south-facing slopes were intermediate. Furthermore, black grama appears to be far less common on gravelly slopes south of Rincon (even on the same soil map unit—Nickel gravelly sandy loam). Thus, the composition of historic plant communities and their resilience to grazing perturbation is highly variable at both small (100 m) and large (100 km) scales, even within restricted areas of SD-2. It may prove useful to split out the gravelly breaks areas from the more level areas as a distinct ecological site.

<u>Diagnosis</u>: Cover of black grama and/or bush muhly and other grasses more or less continuous and occurs in shrub interspaces. Shrub density variable, but typical intershrub distance should be several meters to 10s of meters. Depending upon slope and landscape position, rills, gullies, and arroyos may be common.

Ground Cover (Average Percent of Surface Area).	
Grasses & Forbs	12
Bare ground	45
Surface gravel	35
Surface cobble and stone	3
Litter (percent)	5
Litter (average depth in cm.)	1

Plant Community Annual Production (by plant type):

	Annual Production (lbs/ac)		
Plant Type	Low	RV	High
Grass/Grasslike	89	177	266
Forb	12	24	36
Tree/Shrub/Vine	49	99	148
Lichen			
Moss			
Microbiotic Crusts			
Totals	150	300	450

Historic Climax Plant Community Plant Species Composition: Plant species are grouped by annual production **not** by functional groups.

Group	Grass/Grasslike Common Name	Scientific Name	Annual Production in Pounds Per Acre Low	High
1	black grama	*Bouteloua eriopoda*	45	60
	bush muhly	*Muhlenbergia porteri*		
2	cane bluestem	*Bothriochloa barbinodis*	15	30
	Arizona cottontop	*Digitaria californica*		
	plains bristlegrass	*Setaria vulpiseta*		
3	threeawn	*Aristida*	3	5
4	burrograss	*Scleropogon brevifolius*	3	0
5	pappusgrass	*Pappophorum*	3	15
	slim tridens	*Tridens muticus var. elongatus*		
6	Grass, annual		3	15
	fluffgrass	*Dasyochloa pulchella*		
	sand dropseed	*Sporobolus cryptandrus*		

Group	Shrub/Vine Common Name	Scientific Name	Annual Production in Pounds Per Acre Low	High
7	creosote bush	*Larrea tridentata*	45	60
8	mariola	*Parthenium incanum*	9	15
9	yerba de pasmo	*Baccharis pteronioides*	3	9
	range ratany	*Krameria erecta*		
10	tarbush	*Flourensia cernua*	3	15
	crown of thorns	*Koeberlinia spinosa*		
	littleleaf sumac	*Rhus microphylla*		
11	whitethorn acacia	*Acacia constricta*	3	6
	pricklypear	*Opuntia*		
12	broom snakeweed	*Gutierrezia sarothrae*	3	6
14	winterfat	*Krascheninnikovia lanata*	3	15

Group	Forb Common Name	Scientific Name	Annual Production in Pounds Per Acre Low	High
15	desert holly	Acourtia nana	15	30
	croton	*Croton*		
	buckwheat	*Eriogonum*		
	woolly paperflower	*Psilostrophe tagetina*		
	globemallow	*Sphaeralcea*		
16	Forb, annual		3	15
	Forb, perennial		3	15

Plant Growth Curve:
Growth Curve Number: NM2502
Growth Curve Name: HCPC
Growth Curve Description: SD-2 Gravelly Warm Season Plant Community

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	8	10	12	30	20	10	5	0	0

Transition to shrub-dominated state (1a): Overgrazing is believed to initiate this transition. Gardner (1951) noted that bush muhly was found outside of shrub canopies only in ungrazed sites, indicating that the loss of grasses in interspaces may be caused by grazing. Subsequent competition or loss of intershrub soil fertility, perhaps exacerbated by the allelopathic effects of expanding creosotebush clones, may preclude reestablishment by grasses. Prolonged domination by shrubs may eventually lead to a transition to a shrubland state within which shrub control measures do not result in increased grass cover (transition 3, see below). It is possible that a high cover of stones or gravel may retard erosional soil losses and prolong the window in which grasses may be recovered.

Alternatively, climatic changes and/or reduced fire disturbance may drive this transition on certain landscape positions (i.e. where run-on water is not a factor). Generally, the presence or absence of run-on water will cause large variation in the sensitivity of a gravelly site to grazing. A systematic documentation of these relationships would be an important contribution to our understanding of this site.

<u>Key indicators of approach to transition</u>: Decreases in grass and litter cover, increases in bare patch size, increases in the frequency and size of rills, gullies, and litter movement

Transition to shrubland state (2a): Severe overgrazing causing grass loss with subsequent erosion, gullying, and soil truncation may cause a transition to a shrubland state from which grass does not recover for decades. Severe overgrazing in drought conditions, perhaps followed by heavy summer rains and excessive erosion, may lead a system to bypass the Shrub-dominated state altogether and extinguish most large perennial grasses. In this case, soil loss is often apparent, especially notable in the pedestalling of shrubs.

<u>Key indicators of approach to transition</u>: Decreases, sometimes rapid, in grass and litter cover, increases in bare patch size, increases in the frequency and size of rills, gullies, and litter movement, accumulation of gravel and pebbles at the surface, pedestalling.

<u>**Additional States:**</u>

<u>***Shrub-dominated state***</u>: This state is characterized by a predominance of shrubs (mostly creosotebush and tarbush) with large perennial grasses existing as a subordinate or minor component. Often, shrubs exist as discrete patches with little grass intermixed with areas in which grass is more common and shrub densities are lower. A sparse cover of fluffgrass may occupy the mostly open areas. Localized soil truncation or loss of soil fertility may occur, especially along the sides or arroyos and gullies. In some cases, the erosional-depositional banded vegetation process (e.g. Montana et al. 1990, see Clayey model) occurs on slight (< 1%) slopes where gullying is not apparent. Typically, bush muhly is the dominant grass (Shrubs/bush muhly community), although in some “gravelly hills” situations, black grama persists at low densities (Shrubs/black grama community). This latter situation is often observed on south-facing slopes that are presumably more droughty. On sites with heavier subsurface soils, tobosa may constitute the grass component (Shrubs/tobosa community).

Bush muhly is often associated with the bases of shrubs, and may be almost entirely restricted to shrub bases. Nonetheless, this grass constitutes a high percentage of ground cover. Bush muhly establishment appears to be favored under creosotebush, likely due to the interception of wind-born inflorescences and the concentration of nutrients under shrubs (Whitford et al. 1997). Under these conditions, bush muhly may compete with creosotebush and cause creosotebush decadence once the bush muhly volume occupies more than 50% of the aboveground shrub volume (Welsh and Beck 1976). This interaction, in conjunction with the use of effective herbicides such as Tebuthiron, can increase the abundance of bush muhly within this state (Bush muhly/shrubs community). Threeawns may also increase following this treatment. If localized losses of soil fertility or climatic shifts are associated with the transition, however, the conditions promoting shrub establishment at the expense of grasses may persist. Thus, this community would still occupy the shrub-dominated state because intermittent removal of shrubs would be required to maintain grasses within the system.

<u>Diagnosis</u>: Cover of black grama and/or bush muhly patchy. Bare expanses of several to 10s of meters are typical. Bush muhly and other grasses may be restricted to the bases of shrubs. Shrub density is moderate, typical intershrub distances may be 2–3 m. Rills, gullies, and arroyos may be common. Evidence of sheet flow in large bare areas present. Pedestalling is apparent.

Transition to shrubland state (3): See transition 2a above. Persistent lack of grasses may lead to erosion and soil truncation, and grasses may take decades or more to recover.

Transition to mixed-shrub grassland state (1b): Restoration of self-maintaining grass cover may be accomplished through repeated shrub control events. Where seed limitation is a factor, seeding and furrowing may be used to restore grasses, but Gibbens et al. (1993) found this to be unsuccessful on Tencee soils. The use of gully seeders to release seeds when rains flush washes to seed target areas downslope may have promise (Barrow and Havstad, ms). Contour terraces, on the other hand, have not been successful, although they were not maintained (Rango et al. in press). Protection of sites from native herbivores such as jackrabbits may facilitate natural reestablishment of grasses (Havstad et al. 1998).

Creosotebush state: In this state, perennial grasses of large stature, including black grama and bush muhly, are largely or entirely absent, with a few individual bush muhly persisting under some shrubs. Typically, creosotebush is the overwhelming dominant. Soil truncation is apparent at this stage and the petrocalcic or calcic horizon may be exposed at the surface. Sheetflow erosion with loss of finer particles may concentrate gravel at the surface to produce a barren desert pavement in shrub interspaces. In some cases, creosotebush is the sole perennial plant. On gravelly soils, Buffington and Herbel (1965) documented the eventual loss of tarbush from the shrub mix to dominance by either pure creosotebush or creosotebush with some mesquite. It is unclear in this study what changes to grass cover accompanied these changes in shrub dominance. Grass reestablishment within this state is virtually impossible. Note that it can be difficult to ascertain when sufficient soil erosion has occurred to preclude rapid grass reestablishment. Sites "written off" prematurely may lead to continued erosion and the option of recovering grasses may be lost.

In other cases, shrubs and subshrubs such as mariola and/or zinnia (*Zinnia acerosa*) and *Dyssodia acerosa* may be subdominants (Creosotebush/mariola) and may fluctuate in abundance due to climate. Fluffgrass cover may be significant (Creosotebush/fluffgrass community), and where creosotebush has been controlled using herbicides, or where creosotebush cover is limited by shallow soils due to truncation, fluffgrass may be dominant (Fluffgrass/creosotebush community). Whitethorn acacia (*Acacia constricta*) has invaded and/or expanded within creosotebush shrublands in Las Cruces area over the last 40 years, and might constitute a distinct state.

McAuliffe (1994) and Hamerlynck et al. (2000) have suggested that the limited deep soil water recharge on soils with shallow argillic horizons may limit creosotebush growth. Petrocalcic horizons may similarly retard soil water penetration to deep roots (Gile et al. draft ms). Where roots penetrate the petrocalcic, however, water may be funneled to roots (Gile et al. 1998). If soil truncation prohibits grass establishment above the petrocalcic, but creosotebush can exploit water through pipes and cracks over a large area (Gibbens and Lenz 2001), this may explain the success of creosotebush in comparison to grasses on truncated soils. This mechanism may also explain the contrasting roles of restrictive layers between studies in the Sonoran and Chihuahuan deserts if pipes are not present in the argillic layer of McAuliffe's (1994) study.

Diagnosis: Black grama and/or bush muhly typically absent, although bush muhly may occur the bases of a few shrubs. Shrub density may be high with shrub crowns touching. Rills, gullies, and arroyos may be common. Evidence of sheet flow in large bare areas is present. Pedestalling is common, and soil deflation often produces a desert pavement of packed gravel and small stones.

Transition to mixed-shrub grassland state (2b): Destruction of gullies and the use of water spreaders may be beneficial. Pitting or other erosion stabilization techniques would probably be needed for the accumulation of organic matter. Seeding would be required. Where physical soil crust/pavement has developed, soil disturbance may promote infiltration. If shallow petrocalcic horizons are exposed, grass recovery would not be possible until soil is added or the horizon was destroyed.

Data and information sources and theoretical background: Communities and states are derived largely from information obtained using broad-scale associations recorded by Buffington and Herbel (1965) and Gardner (1951) and by field observations of Brandon Bestelmeyer, USDA-ARS Jornada Experimental Range, Gene Adkins, NRCS Truth or Consequences, Jim Powell, NRCS, retired. Studies by Buffington and Herbel (1965) and Whitford et al. (2001) directly address transitions on gravelly soils in SD-2, and Herbel et al. (1973) and Jerry Barrow and Kris Havstad (unpublished ms) discuss restoration strategies.

Three hypotheses for transitions between mixed shrub grassland and shrub-dominated and shrubland states can be identified. Patterns observed by McAuliffe (1994), Gibbens and Lenz (in review) and discussed by Gile et al. (draft ms) support the *soil truncation hypothesis*. This holds that erosion due to disturbance-induced loss of plant cover, or due to natural, long-term processes, removes soil surface horizons, bringing the calcic or petrocalcic horizon (a characteristic of gravelly site soils) closer to the surface. Because carbonate is relatively impermeable, this may cause runoff to increase and infiltration to decrease. This, in turn, inhibits the establishment of grass, as well as shrubs, and may stress existing shrubs. Despite this stress, shrubs may come to dominate under these conditions by exploiting deeper soil layers through gaps in petrocalcic layers and reproducing via clonal growth. Water may also be funneled and concentrated through gaps (similar to the effect of krotovinas created by burrowing animals; Gile et al. 1997). Increases in creosotebush via clonal growth may require long periods of time without disturbance (McAuliffe 1994).

The scenario outlined by Whitford et al. (2001) can be referred to as the *allelopathy* hypothesis. This explanation proposes that grazing and/or drought creates gaps in the cover of black grama that permit increasing dominance by creosotebush. As creosotebush develops free from competition with grass, it increasingly releases allelopathic chemicals from litter fall that is detrimental to the soil fauna and flora. This, in turn, increases decreases infiltration and nutrient availability, increases erosion, and inhibits grass germination. Alternatively, creosotebush may be a more effective competitor for surface soil water than grasses (the *competition* hypothesis). Thus, the allelopathy and competition hypotheses can be complementary to the soil truncation hypothesis. Allelopathic/competitive effects of creosotebush may contribute to soil truncation. In both cases, *the nutrient concentration hypothesis* (Schlesinger et al. 1990; see Sandy model) explains the persistence of shrubs under these conditions.

If the mechanism of Whitford et al. operates, then the expansion of creosotebush is the key process responsible for the transition from mixed shrub grassland to a shrub-dominated state. Allelopathic effects may lead to the eventual replacement grasses over time without shrub control. Remediation under this scenario may be difficult, especially if the allelochemicals have persistent effects. On the other hand, if the allelopathy hypothesis is false, then there may be stable coexistence of creosotebush and grasses and grazing management may prevent further degradation even after shrubs have begun to encroach into previously shrub-free settings. In some areas at least, creosotebush has coexisted with grasses for long periods, so some unrecognized factors may limit creosotebush establishment and dominance (perhaps soil instability; McAuliffe 1994). Alternatively, the allelopathy mechanism may not operate in many, or any, situations.

The *climate change hypothesis* may also explain the expansion shrubs into areas of grassland (Neilson 1986; see the Sandy model) and the decline of grasses, especially black grama. The persistence of black grama on certain landscape positions (see below), however, indicates that climate alone is not responsible for the loss of black grama. Reynolds et al. (1999) found that creosotebush is very flexible in the seasonal use of moisture and can adapt its periods of physiological activity to match periods of soil moisture availability. Thus, areas dominated by black grama receiving run-on water may be buffered from the effects of climate change that are important in other landscape positions (e.g. plains). In run-in positions, black grama can continue to successfully impede creosotebush establishment, whereas in other settings, creosotebush has experienced competitive release under the current climate and can capitalize on its physiological flexibility. A *reduction in fire frequency* may also be associated with grass reduction and shrub expansion, although there is little evidence in support of this mechanism in the gravelly setting.

Ecological Site Interpretations

Animal Community:

This range site provides habitats which support a resident animal community that is characterized by desert muledeer, coyote, desert cottontail, Merriam's kangaroo rat, white throated woodrat, cactus mouse, golden eagle, scaled quail, crissal thrasher, black-throated sparrow, collared lizard, round-tailed horned lizard, striped whipshake and Couch's spadefoot toad.

Woody vegetation of associated desert washes concentrate wildlife and provide breeding areas for mourning dove, Swainson's hawk and roadrunner.

Hydrology Functions:

The runoff curve numbers are determined by field investigations using hydraulic cover conditions and hydrologic soil groups.

Hydrologic Interpretations	
Soil Series	Hydrologic Group
Upton	C
Delnorte	C
Nickel	B

Recreational Uses:
Recreation potential is limited largely by the hot summers and windy spring weather of the Lower Sonoran Life Zone, Within which the site is located. Suitability for camping and picnicking is fair, the site is generally suitable for rock hounding, and hunting is limited primarily to quail, dove, and small game. Photography and bird watching can be worthwhile, especially during migration seasons. Most small animals are nocturnal and secretive, seen only at night, early morning, or evening. Scenic beauty is greatest during spring and sometimes summer months when flowering of shrubs, forbs, and cacti occurs.

Wood Products:
This site has no significant value for wood products.

Other Products:

This site is suitable for grazing in all seasons of the year, although most of the green forage is produced during the months of July, August, and September. The site is adapted for use by all classes of livestock. It is not, however, a highly productive site, and good management is essential to either maintain or to improve condition. Retrogression is characterized by an almost total take – over by woody plants, chiefly creosotebush, and by low – value grasses such as fluffgrass. Recovery is extremely slow and woody plant control may be needed to effect a reasonable rate of recovery.

Other Information:

Similarity Index	Guide to Suggested Initial Stocking Rate Acres per Animal Unit Month Ac/AUM
100 - 76	7.3 – 8.5
75 – 51	8.3 – 10.0
50 – 26	9.5 – 26.0
25 – 0	26.0 - +

Plant Preference by Animal Kind:

	Code	Species Preference	Code
Stems	S	None Selected	N/S
Leaves	L	Preferred	P
Flowers	F	Desirable	D
Fruit/Seeds	F/S	Undesirable	U
Entire Plant	EP	Not Consumed	NC
Underground Parts	UP	Emergency	E
		Toxic	T

Animal Kind: Livestock

Animal Type: Cattle

Common Name	Scientific Name	Plant Part	Forage Preferences J	F	M	A	M	J	J	A	S	O	N	D
fourwing saltbush	Atriplex canescens	EP	P	P	P	P	P	D	D	D	D	D	P	P
cane bluestem	Bothriochloa barbinodis	EP	D	D	D	D	D	P	P	P	D	D	D	D
Arizona cottontop														
black grama	Bouteloua eriopoda	EP	P	P	P	D	D	D	D	D	D	D	P	P
winterfat	Krascheninnikovia lanata	P	P	P	P	P	P	D	D	D	D	P	P	P
bush muhly	Muhlenbergia porteri	EP	P	P	P	P	P	P	P	P	P	P	P	P
Sand dropseed	Sporobolus cryptandrus	EP	U	U	U	D	P	P	D	D	D	U	U	U
plains bristlegrass	Setaria vulpiseta	EP	D	D	D	D	D	P	P	P	P	D	D	D

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Gravelly Sand	R042XB024NM	
Gravelly Loam	R042XB035NM	
Loamy	R042XB014NM	
Sandy	R042XB012NM	

Similiar Sites:

Site Name	Site ID	Site Narrative
Gravelly Sand	R042XB024NM	
Gravelly Loam	R042XB035NM	
Sandy	R042XB012NM	

State Correlation:
This site has been correlated with the following states: Texas

Inventory Data References:

Data Source	Number of Records	Sample Period	State	County

Type Locality:

Relationship to Other Established Classifications:

Other References:
Data collection for this site was done in conjunction with the progressive soil surveys within the Southern Desertic Basins, Plains and Mountains, Major Land Resource Areas of New Mexico. This site has been mapped and correlated with soils in the following soil surveys. Sierra County Dona Ana County Grant County Hidalgo County Luna County Otero County

Characteristic Soils Are:	
Upton gravelly loam	Nickle gravelly loam, gravelly sandy loam, very gravelly loam, or very gravelly sandy loam
Cave gravelly sandy loam	Tencee very gravelly loam
Delnorte very gravelly loam	
Other Soils inclded are:	
Tres Hermanos gravelly loam	Conger gravelly loam, fine sandy loam
Terino very gravelly sandy loam	Tres hermanos gravelly sandy clay loam
Casito very gravelly sandy loam	Tres hermanos sandy loam
Chamberino gravelly loam	Upton clay loam (mapped in a complex in Grant County)

Site Description Approval:

Author	Date	Approval	Date
Don Sylvester	07/12/1979	Don Sylvester	07/12/1979

Site Description Revision:

Author	Date	Approval	Date
Dr. Brandon Bestelmeyer	05/22/02	George Chavez	05/23/02
George Chavez	05/22/02		